

4729

Mark Scheme

January 2008

# 4729 Mechanics 2

<b>1 (i)</b>	$12 \times \cos 55^\circ$ $6.88 \text{ m s}^{-1}$	M1 A1 <b>2</b>	
<b>(ii)</b>	$12 \times \cos 55^\circ \times 0.65$ $(\pm) 4.47 \text{ m s}^{-1}$ ✓	M1 A1 <b>2</b>	✓ $0.65 \times \text{their (i)}$ <b>4</b>
<b>2</b>	$F = 0.2 \text{ mg} \cos 30^\circ$ $0.2 \text{ mg} \cos 30^\circ \times d$ $\text{mg} \times d \times \sin 30^\circ$ $d = \frac{1}{2} \times 25 / (0.2 \times 9.8 \cos 30^\circ + 9.8 \times \sin 30^\circ)$ $1.89 \text{ m}$	M1 A1 B1 B1 M1 A1 <b>6</b>	= = $(1.6974 \text{ m}) (49\sqrt{3}/50 \text{ m})$ $a = 0.2g \cos 30^\circ + g \sin 30^\circ$ $a = (\pm) 6.60$ $0 = 5^2 - 2 \times 6.60d$ <b>6</b>
<b>3</b>	direction of R perp. to wall R at $70^\circ$ to rod $0.8 \times 25 \cos 60^\circ = 1.6 \times R \sin 70^\circ$ $0.8 \times 25 \cos 60^\circ$ $1.6 \times R \sin 70^\circ$ $R = 6.65 \text{ N}$	B1 B1 M1 A1 A1 A1 <b>6</b>	$10^\circ$ to horiz. moments about A <b>6</b>
<b>4 (i)</b>	$45\,000/v = kv$ $k = 50$	M1 A1 <b>2</b>	<b>AG</b>
<b>(ii)</b>	$45\,000/20 - 50 \times 20 = 1200a$ $a = 1.04 \text{ m s}^{-2}$	M1 A1 A1 <b>3</b>	
<b>(iii)</b>	$P/15 = 50 \times 15 + 1200 \times 9.8 \sin 10^\circ$ $41\,900 \text{ W}$	M1 A1 A1 <b>3</b>	<b>8</b>
<b>5 (i)</b>	$2mu - 3kmu = -mu + kmv$ $v = \dots$ $v = 3u(1 - k)/k$ $(0 <) k < 1$	M1 M1 A1 A1 <b>4</b>	attempting to make v the subject $3u/k - 3u$ not $\leq 1$
<b>(ii)</b>	$I = mu - - 2mu$ $3mu$	M1 A1 <b>2</b>	or $km(3u/k - 3u + 3u)$ + only
<b>(iii)</b>	$v = \pm 3u$ $e = (u/2 + 3u)/4u$ $e = 7/8 \text{ or } 0.875$	B1 M1 A1 <b>3</b>	<b>9</b>

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<b>6 (i)(a)</b>	$T \cos 45^\circ = 2.94$ $T = 4.16 \text{ N}$	M1 A1 <b>2</b>	Resolving vertically <b>AG</b>
<b>(b)</b>	$T \cos 45^\circ + T = 0.3 \times 1.96 \omega^2$ (res. horiz.) $\omega = 3.47 \text{ rad s}^{-1}$	M1 A1 A1 <b>3</b>	calculates $v = 6.81$ (Max 2/3)
<b>(ii)(a)</b>	$T \cos 30^\circ + T \cos 60^\circ = 2.94$  $T = 2.15 \text{ N}$	M1 A1 A1 <b>3</b>	Resolving vertically
<b>(b)</b>	$T \cos 30^\circ + T \cos 60^\circ = 0.3v^2/1.5$ (res. horiz.) $v = 3.83 \text{ m s}^{-1}$	M1 A1 A1 <b>3</b>	calculates $\omega = 2.56$ (Max 2/3)

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<b>7 (i)</b>	$0 = (175 \sin \theta)^2 - 2 \times 9.8 \times 650$  $\theta = 40.2^\circ$	M1 A1 A1 <b>3</b>	
<b>(ii)</b>	Attempt at $t_1, t_2, t_{\text{top}}$ or $t_{\text{total}}$ 5.61, 23.65, 14.63, 29.26 $t_2 - t_1$ or $2(t_{\text{top}} - t_1)$ or $t_{\text{total}} - 2t_1$  time difference = 18.0	M1 A1 M1 A1  A1 <b>5</b>	$650 = 175 \sin 55^\circ \cdot t - 4.9t^2$ etc
<b>(iii)</b>	$v_h = 175 \cos 55^\circ$ (100.4) $v_v = 175 \sin 55^\circ - 9.8 \times 5.61$ speed = $\sqrt{(88.4^2 + 100.4^2)}$ $134 \text{ m s}^{-1}$	B1 M1 M1 A1 <b>4</b>	or KE $\frac{1}{2}mv^2$ (B1) PE $mx9.8 \times 650$ $v = \sqrt{(175^2 - 2 \times 9.8 \times 650)}$

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<b>8 (i)</b>	$(2 \times 4 \times \sin \Pi/2) / 3 \times \Pi/2$ 1.70	M1 A1 <b>2</b>	or $4r/3\Pi$ <b>AG</b>
<b>(ii)(a)</b>	$\bar{x} \times d(8 \times 20 - \Pi \times 4^2/2) = 10 \times 8 \times 20d - 12 \times \Pi \times 4^2/2 \times d$ $10 \times 8 \times 20(d)$ (1600) $(8 \times 20 - \Pi \times 4^2/2)(d)$ (134.9) $(12 \times \Pi \times 4^2/2)(d)$ (301.6) $\bar{x} = 9.63 \text{ cm}$	M1  A1 A1 A1 A1 <b>5</b>	or $134.9 \bar{x} = 64 \times 4 + 38.9 \times 12 + 32 \times 18$ (1298.8) $64 \times 4$ $38.9 \times 12$ $32 \times 18$ <b>AG</b>
<b>(ii)(b)</b>	$\bar{y} \times d(8 \times 20 - \Pi \times 4^2/2) = 4 \times 8 \times 20d - 1.7 \times \Pi \times 4^2/2 \times d$ $4 \times 8 \times 20(d)$ $1.7d \times \Pi \times 4^2/2$ (13.6\Pi) $\bar{y} = 4.43 \text{ cm}$	M1  A1 A1M1 A1 <b>4</b>	or $64 \times 4 = 42.7 + 38.9 \bar{y}$ $\bar{y} = 5.49$ $135 \bar{y} = 32 \times 4 + 38.9 \times 5.49 + 64 \times 4$
<b>(iii)</b>	$20 \cos 10^\circ \times T$ $15 \cos 10^\circ \times 9.63$ $15 \sin 10^\circ \times 4.43$ $20 \cos 10^\circ \cdot T = 15 \cos 10^\circ \times 9.63 - 15 \sin 10^\circ \times 4.43$ (needs 3 parts) $T = 6.64 \text{ N}$	B1 B1 B1 M1  A1 <b>5</b>	= or 10.6 (A to com) $34.7^\circ \angle \text{comAH}$ $= 15 \times 10.6 \times \cos 34.7^\circ$

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